The interstellar gas-phase chemistry of HCN and HNC

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We review the chemistry involving HCN and HNC in dark molecular clouds to elucidate new chemical sources and sinks of these isomers. We find that the most important reactions for the HCN-HNC system are Dissociative Recombination (DR) reactions of $HCNH^+$ ($HCNH^+ + e^-$), the ionic CN + H_3^+, HCN + C^+ reactions, HCN and HNC reactions with $H^+/He^+/H_3^+/H_3O^+/HCO^+$, the N + CH_2 reaction and two new reactions: H + CCN and C + HNC. We test the effect of the new rate constants and branching ratios on the predictions of gas-grain chemical models for dark cloud conditions. The rapid C + HNC reaction keeps the HCN/HNC ratio significantly above one as long as the carbon atom abundance remains high. However, the reaction of HCN with H_3^+ followed by DR of $HCNH^+$ acts to isomerize HCN into HNC when carbon atoms and CO are depleted leading to a HCN/HNC ratio close to or slightly greater than 1. This agrees well with observations in TMC-1 and L134N taking into consideration the overestimation of HNC abundances through the use of the same rotational excitation rate constants for HNC as for HCN in many radiative transfer models.